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Novel coronavirus (COVID-2019) pandemic: Common challenges and responses from higher education providers

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Abstract

There has been an unprecedented impact on the higher education sector from the novel coronavirus (COVID-19) since the first reports in Wuhan, Hubei Province, China. As it has rapidly become a global pandemic, universities had to implement appropriate policies for responding to it. Most higher education providers have adapted a range of online learning, teaching and assessment approaches as a response to the pandemic. This paper systematically reviews such responses from higher education providers in various parts of the world and evaluates the challenges and impacts on supporting students in learning and teaching during COVID-19.

1. Introduction

The novel coronavirus (COVID-19) has triggered an outbreak that was first identified in Wuhan City, Hubei Province, China in November 2019 (Syed, 2020). Since then, viral cases were reported rapidly not only in Asian countries, but also in Europe, Africa, the Americas and Australia leading to a global deadly pandemic (Global Center for Health Security, 2020). With the absence of medicine or vaccine to successfully treat against COVID-19, the number of cases continues to increase, and many countries already experience the second wave of the coronavirus.

Social distancing and self-isolation are highly recommended as preventive measures and have significantly impacted on all educational branches: primary, secondary, higher education and research (La et al., 2020). Public health officials recommend social distancing to flatten the infection curve and to reduce the fatalities upon closure of universities and schools around the world (Murphy, 2020). Social distancing or physical distancing has been identified as the most important pandemic precaution as it reduces interpersonal contact, minimising the community transmission especially in dense social networks such as university campuses (Rashid & Yadav, 2020).

For example, Figure 1 shows the number of learners (i.e. learners at pre-primary, primary, lower-secondary, upper-secondary, and tertiary levels of education) impacted by national closures of educational systems worldwide as of March 23, 2020, according to figures released by UNESCO (McCarthy, 2020). At the beginning of the pandemic, over 1.3 billion students have been impacted worldwide as the whole world came to a virtual standstill. Figure 2 depicts the state of disruption and the proportion of affected tertiary education students out of the regional total tertiary student populations as of April 8, 2020 (World Bank Group, 2020a). Regardless of the region, rapid response plans were put in place to coordinate the required massive efforts due to the closing down of entire education systems throughout the world. The global survey report of the IAU (International Association of Universities) has clearly presented the impact of COVID-19 on higher education around the world on different aspects including teaching and learning, international student mobility research, key challenges, and potential opportunities and changes in financials (Marinoni et al., 2020).

Scientists have foreseen the necessity of long-term plans in all aspects to mitigate the worldwide pandemic. It has impacted both local and international degree programmes, research, recruitments, funding, and many more activities (Bolton, 2020; Pietrocola, 2020). The UNESCO Director-General has stated: "We are entering uncharted territory and working with countries to find hi-tech, low-tech and no-tech solutions to assure the continuity of learning" (UNESCO & IESALC, 2020). Additionally, UNESCO's Assistant Director-General for Education emphasised: "We need to come together not only to address the immediate educational systems" (UNESCO & IESALC, 2020).

In response to the closure of all academic institutions including schools and universities, UNESCO recommended distance learning using online platforms, and the approaches of distance learning are a timely consideration to continue education with minimal disruption. COVID-19 infections had spread throughout the world so rapidly that the WHO declared a pandemic on 11 March 2020 (Rashid & Yadav, 2020). The below data and statistics clearly depict the huge impact on higher education at the early stages of this pandemic. It had been reported that from mid-May 2020, EU/EEA countries have started to partially re-open schools as shown in Figure 3 below (European Centre for Disease Prevention and Control, 2020). The UNESCO International Institute for Higher Education in Latin America and the Caribbean (IESALC) highlights the importance of initiating quality and equity of higher education in the short, medium, and long term during the global COVID-19 outbreak.

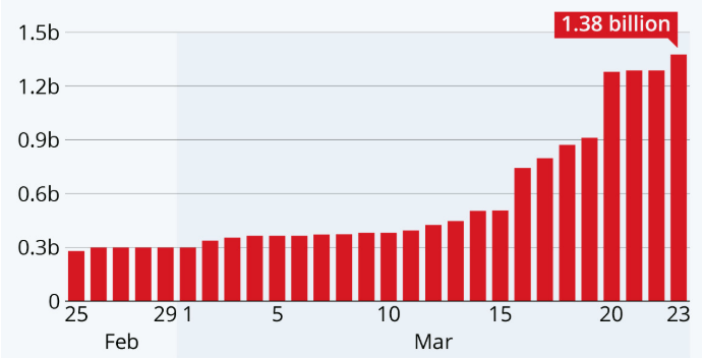

Figure 1: Impact of COVID-19 on global education; learners enrolled at pre-primary, primary, lower-secondary, upper-secondary, and tertiary levels of education (McCarthy, 2020)..

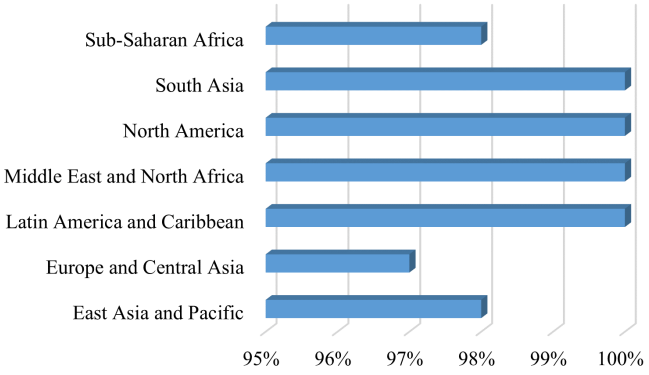

Figure 2: Total affected tertiary education students by region (World Bank Group, 2020a).

Although originally, online education was oftentimes used as a supplement to regular education, the outbreak of COVID-19 has forced online education to be put into practice as an immediate solution to mitigate the discontinuity of education (Tamura, 2008; Naciri et al., 2020). Action plans have been adopted based on the accessibility of infrastructure and resources to obtain the best outcome in online remote education.

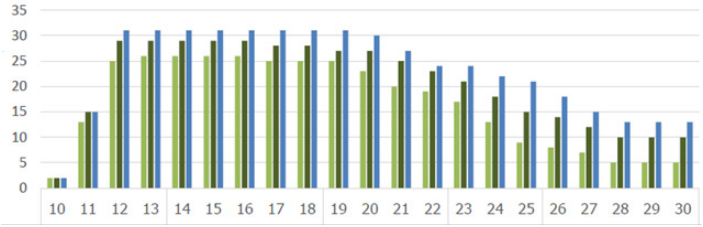

Figure 3: Total number of EU/EEA countries and the UK (N=31) that enacted some form of school closure during the pandemic[1] (European Centre for Disease Prevention and Control, 2020).

2. Methodology

The resource base for the review presented in this paper consists of citation databases of peer-reviewed literature, the review of web-based provisions of selected universities, institutional and national policy documents, survey reports, and other studies. The search was conducted based on keywords of "COVID-19, university or higher education, online education/learning/teaching" of the title and abstract.

This paper systematically presents the common challenges and approaches taken by the higher education sector in response to COVID-19 as a result of the worldwide lockdowns and social distancing. It summarises the impacts of COVID-19 on academic delivery and assessments and discusses the technologies used by the academic community to minimise the impacts. Impacts on students as well as staff including their mental health and wellbeing are also explored. The paper also highlights the importance of quality assurance mechanisms, and summarises the approaches taken by the higher education providers to strengthen the quality assurance mechanism during this period.

3. Academic delivery

Education cannot be put on hold and it has become a consensus to proceed with the next generation information technologies. There is no doubt that most universities and related academic institutions had no solid plan to implement during a sudden unforeseen pandemic. The resistance to adaptation under emergency conditions can swiftly expand the spread of the virus. Utilising online technologies for educational settings resulted in a reduction of the transmission of the coronavirus (i.e. reproductive value, R). They greatly reduce the potentially big clusters due to reduced social contacts, while reducing the R-value to manageable levels (Park et al., 2020). The abrupt interruption of face-to-face teaching may inevitably require adequate time to switch entirely to a virtual environment, mediated by different technological tools. All academic institutions including universities, colleges, and schools recognise that adjustments and online platforms are essential for delivery and assessment methods to maintain social distancing and to practice remote learning (Viner et al., 2020). However, there are serious aspects to consider in terms of teaching disciplines, including what and how to teach paying careful attention to the workload and teaching environment (Ali, 2020).

Transforming all existing course modules to an online mode requires well-planned, highly structured lesson plans and teaching materials, including audio and video content with IT support teams. In ramping up capacity to teach remotely at short notice, academics and administrative officials had to take pragmatic approaches to manage educational consequences during the crisis (Daniel, 2020). In the case of large-scale school closures, continuity of education has been initiated through partnering with television and radio stations as a public broadcast, according to a given timetable for essential basic subject matters. It has been reported that there can be several types of online learning, namely online support, asynchronous training, synchronous training, and hybrid training (Chen et al., 2005). State education agencies have provided guidelines and recommendations stating best practices for remote learning during the closure of education systems (Reich et al., 2020).

Moreover, taking care of all the online module delivery, there are specific basic sciences and application-based programmes, such as engineering, medical, agricultural degrees, that require laboratory practical sessions to enhance students' hands-on experience and related laboratory work. Hence, courses with a high level of hands-on components have the greatest impact on laboratory experiments, clinical, performing arts, and research laboratories. Particularly, students involved in these fields need much attention for completing essential learning components to fulfil their graduation requirements. These aspects can be addressed partially by providing them with video links to watch the experiments and conducting sessions through virtual online labs or providing them with a data set to replicate the lab measurements, so that students can do the analysis and complete relevant reports and assessment tasks. Deakin was among the first of the universities to conduct laboratory components accompanying both remote laboratories and lab kits (Long, 2020).

It is recommended that faculty consider two phases of teaching involving offline self-learning along with online teaching (Bao, 2020). By combining online learning and self-learning can effectively overcome poor pre-class study preparation, participation, and lack of open and deep discussions and the live engagements. Among a set of educational approaches, flexible learning provides choices in the educational environment as a learner-centered educational strategy. Individual learners have the opportunity to choose when, where, and how learning occurs upon their choice, convenience to suit their desire which promotes easy, engaged, and effective learning (Huang et al., 2020). Open learning is among new learning modes which make learners more self-determined and independent and academics act as learning facilitators. One of the other characteristics of flexible learning is that learners are more responsible for their own learning setting goals, self-monitoring in achieving active learning.

1Totals are the sum of countries that had any form of school closure or restrictions in place at each specific point in time, including those with only partial closures in place.

4. Online technologies

Previous outbreaks of infectious diseases have led to the effective control of widespread diseases. Evidence could be provided from the 1918-1919 influenza pandemic, the 2009 H1N1 Flu pandemic or SARS, for instance (World Health Organization, 2009; Wong et al., 2005). Facilitating flexible online learning strategies is encouraged by the Chinese Ministry of Education based on six dimensions, namely: (1) infrastructure, (2) learning tools, (3) learning resources, (4) teaching and learning methods, (5) services for teachers and students and (6) cooperation between government, enterprises, and schools (Huang et al., 2020). Online education requires information and communication technologies (ICT) for the development and acquisition of knowledge from various modes including the internet, video/audio, and software to create an online learning environment (Basilaia & Kvavadze, 2020).

Not each university is well prepared for a complete online teaching and learning transformation. The readiness of both academics and students matters, apart from the necessity of technological support in the development of teaching capacities for virtual education. Different platforms have been experimented with to facilitate access to e-disciplines and to teach in e-classrooms through video streaming while simulating physical classroom settings (UNESCO & IESALC, 2020).

Internet access is not always possible and good connectivity with a stable bandwidth often lacking and not up to the required quality. Telecommunication facilities must be up to scratch and promoted nation-wide for uninterrupted e-learning. Facilitating necessary resources such as e-books and e-library facilities and encouraging self-studying is potentially a better approach for senior students.

Most commonly and widely used Learning Management Systems (LMS) such as Moodle and Kolibri have been used in facilitating connectivity between students and academics (REMS, 2020; World Bank Group, 2020b). Social media can also be used in a more meaningful way as an instant solution. Free social media sites such as Twitter, Facebook, LinkedIn, and Instagram create a channel allowing them to send announcements and information more easily as students, parents, faculty may all use social media on a regular basis. Furthermore, they can be customised in settings and group chats can be rendered private for more official conversations. This approach is more advantageous particularly as they are easily accessible on a variety of devices such as computers, tablets, and even on mobile phones (REMS, 2020). One of the other approaches would be to build a partnership with online education portals such as edX, Udacity, Udemy, Khan Academy or Coursera, providing students with the ability to continue their studies in the context of emergency remote learning until the time when in the longer run a more convenient and engaged setup is established (Powers & Azzi-huck, 2016).

Considering the difficulty in quick adjustments and the varied availability of infrastructure, it is important to offer flexibility in online platforms. The flexibility to deliver lectures and the availability of teaching materials and resources are not restricted to fixed time slots. Commonly used LMS platforms include Blackboard, SharePoint, and Moodle, as they give much room to engage both students and academics (Basilaia & Kvavadze, 2020). Moreover, the use of narrated PowerPoint slides enables self-learning opportunities for students who live in countries which have internet data restrictions. Institutions can use periodic tracking and participation checking to monitor students' online engagements.

There is a growing amount of documented evidence that enhances our understanding for conducting digital-based education during COVID-19 (Butler-Henderson et al., 2020). However, the suitability and feasibility of all these online tools depend on the availability of the correct hardware, software, networks, and storage capacity of relevant parties to drive smooth online learning and meet the required quality in online traffic and connectivity, especially for live and recorded sessions (Crawford et al., 2020). Hence, global challenges related to online infrastructure can be identified most commonly as issues with the internet. Low internet speed or weakness of the internet in many countries, or high prices for stable internet connections in most parts of the world, directly impact online education.

5. Assessment methods

Undoubtedly, online platforms are becoming more crucial to ensure uninterrupted education due to the coronavirus. Concerns have been raised about online technologies as regards continuous assessments and exams, in terms of ensuring authenticity, reliability, validity, consistency and standards, while maintaining the integrity of assessment methods. As COVID-19 rages all over the world, responsible health bodies are still unable to indicate when normal operations will resume, and how to estimate future developments. This unpredictable nature of COVID-19-related developments had caused cancellations and suspensions of continuous assessments and examinations by many examining bodies in most parts of the world, unfortunately (Merkl-Davies et al., 2001).

Due to restrictions and limitations associated with each discipline, it may be impossible to conduct assessments entirely on virtual online platforms. The absence of invigilators and supervisors to monitor assessment online could also be a major issue and may results in all the assessments to be considered as 'open book'. In this case, the lecturer should be innovative and creative enough to set assessments to test students' enquiry and problem-solving skills. As students are working remotely, there is no guarantee whether they work independently. Yet, there are ways of online evaluating methods using improved online platforms such as Moodle or Blackboard to conduct examinations. Preparation of question banks and using shuffled questions and answers provide more effective testing capabilities to minimise cheating (Ghabraie, 2020). It was reported that major international examinations have been suspended, including Cambridge IGCSE, Cambridge O Level, International AS & A Level, etc., which will eventually impact future student recruitment in higher education (Bandoh, 2001). Considerable thought has been put into

basing module grading on continuous assessment mode where possible. Examinations can still be planned on online platforms such as Moodle and Blackboard with a focus on assessing students' higher order thinking skills.

6. Other challenges

Remote learning guidance from the state education sector emphasises equity in access to online technologies and proper guidance as students will have varying levels of support and family supervision for remote learning. The importance of being attentive to students with special needs is highlighted in coping to help them during periods of disruption to provide accessible forms of learning (Reich et al., 2020). Universities and colleges have important decisions to make in response to sudden closures which could affect various stakeholders both in the short and long-term (Illanes et al., 2020). Undoubtedly, a notable number of students will fail to graduate on time, not being able to complete the necessary requirements due to a lack of infrastructure and support.

Delay in graduation will also be recommended for some of the graduate programmes, particularly those involving hands-on laboratory experience, field training, industrial training, etc. Due to the restrictions of having large events, graduation ceremonies and commencements will have to be performed either on virtual platforms/in drive-in type fashion or be organised in order to have minimal interactions while maintaining social distancing. Graduate and postgraduate level Masters and thesis/ public dissertation defenses may have to be conducted through online platforms such as Zoom or Google Meet allowing committee and public audience to stay connected (Sun et al., 2020).

As travelling is greatly limited throughout the world, its impact is manifold, including overseas research collaborations, international conferences, and many other academic and research activities. Further, these travel restrictions may also limit the new intake for the undergraduates and graduate programs, including international scholarships. And the on-campus orientation will have to be conducted in an online mode, while limiting opportunities for students to experience university life (Bevins et al., 2020; Chinazzi et al., 2020).

6.1 Impact on students

Studying from home has many challenges. The absence of a proper home environment – without a proper study room; distraction from family members including caring responsibilities for older family members, etc. – can negatively impact on students' ability to focus on their studies. Students being left isolated at home may lead to having a lack of self-discipline. Remote online education triggers other issues such as a lack of self-control and self-learning ability due to a lack of face-to-face interaction and supervision (Tamura, 2008). Apart from that, students from the lower socio-economic status may experience a stressful home environment as opposed to their peers from a higher socio-economic status where they could get the help in handling problems from the educated people surrounding them (Di Pietro et al., 2020). Due to the switch from physical to online education, a reduction in learning motivation as a result of a change in the way students interact can be expected (Di Pietro et al., 2020).

Attention is needed in terms of resources, especially from the students' end as well. Furthermore, the students' perceptions and aspirations are key aspects in shifting to a more self-directed learning environment from a conventional teacher-controlled environment (Ali, 2020). It is not reasonable to expect all the students to have PC's or laptops at home with proper working stations equipped with printers, scanners, etc. Some of the students might try to work using smartphones, although smartphones are not able to satisfy all the features that desktops or laptops do. Lack of data and expensive data packages have also restricted their online access, especially in developing countries, as they are not ready for the complete implementation of countrywide online education on such a short notice.

The COVID-19 outbreak has disturbed student life in various ways. Students who are coming to the end of one phase of their education, and those who are transitioning from school to tertiary education, or completing tertiary education to step into employment, are facing unavoidable challenges in their future environment. Students who planned to apply for scholarships and admission to foreign universities for higher education will also suffer long-term disadvantages as they enter the employment market.

Despite taking all the necessary actions for a proper continuation of remote learning, students encounter difficulties engaging properly in technical or vocational education, or any other training programmes. These programmes generally provide the key experience needed for a professional career. With the current COVID situation, it is near-impossible to provide such practical training. Graduate and final-year undergraduate students are required to complete their thesis projects, but as a result of the remote delivery, completion of projects becomes a complex matter. Most students are required to collect experimental data; complete field visits including collecting samples; engage in site investigations; visit foreign countries for their collaborations. As a result of the inability to perform experiments in a timely manner, there could be samples of no use and waste of all the expensive resources, particularly when it comes to activities in chemical and biochemical laboratories.

Proper care must be taken preserving sensitive samples and maintaining special laboratories (eg: UHV-Ultra-high vacuum). These include large and expensive equipment and machinery, where leaving them unattended and inactive for a prolonged time due to COVID-19 will noticeably reduce the usable lifetime. Fortunately, for those who are in the field of theoretical studies, data sciences and social sciences are unaffected due to the availability of a large number of online libraries, archives, and databases, and remote access to supercomputers to run simulations. Online video conferencing, for instance through Zoom, allows group meetings which facilitate periodic discussions and support from supervisors and advisors while sharing and

presenting their data and results. Most of the universities are going forward with online thesis defenses through online platforms, thus avoiding unnecessary delays in the graduation of postgraduate students.

6.2 Impact on academic staff

It is quite obvious that some of the senior academics resist new modes of delivery. In the absence of face-to-face communication, converting the content of a particular module for online delivery may be time-consuming. On top of that, there could be difficulties with adjusting to the use of more sophisticated online technologies. Putting greater effort while innovating and designing, is also important to increase the attention span of students rather than continuing their traditional delivery methods (Blankenberger et al., 2020). It is significantly dependent on the lecturers' capability to carefully turn students from passive recipients to engaged learners by making live sessions more interactive and encourage Q&A's and open discussions. The academics with conventional teaching practices may have fears which lead them to perceive themselves as unsuccessful teachers who fail in going forward with online delivery. Academics also could face a similar uncomfortable situation as students, when working from home and lacking a proper home environment to work peacefully and quietly. Therefore, empowering academics' desire and confidence in implementing ICT-integrated teaching is essential for effective academic delivery in the first place (Ali, 2020).

When it comes to the delivery of lectures, there are crucial tools involved in successful delivery such as body language, facial expressions, and lecturer's voice. These important aspects of teaching become restricted and hinder the outcome. To utilise the voice effectively, slowing down the lecturer's voice would help students to grasp the key knowledge points (Bao, 2020). The need for professional development for both academic staff and students is another crucial area to address, although it takes time. The computer literacy and video presentation skills and new technology to deliver lectures include online platforms such as Zoom and MS Teams. If a student needs extra help, the lecturer could accompany support from teaching assistants or answer questions through email or social media (WhatsApp, WeChat: Bao, 2020).

Faculty have little control over student engagement in their online learning environment. For example, students can easily skip classes or cheat when it comes to participation during online lectures. One approach to address this issue is by increasing students' inspiration and morale to actively engage in learning outside of the class by modifying reading and assignments relevant to their courses. Furthermore, it is the students' responsibility to adapt in order to thrive during ambiguous times such as the COVID-19 pandemic and develop proficiency in being a lifelong learner (Qadir, 2020).

6.3 Health and wellbeing

Undoubtedly, many individuals encounter a wide variety of emotions, such as being anxious, uncomfortable, stressed, depressed, and hopeless, due to the sudden, unexpected, and uncertain COVID-19 pandemic and lockdown (American Council on Education, 2020). Uncertainty in every aspect, such as changes in studies and their financial situations, triggers the question as to when life will be back to normal (Bolton, 2020). In general, it is critically important to address emotional and psychological challenges such as demotivation, both for students and academic staff. Studies have emphasised the fact that the prolonged closure of schools and universities, and home confinement under uncertain conditions, have serious effects on children's physical and mental health (Pragholapati, 2020). Loss of social contact and socialisation routines on a daily basis render students' mentality vulnerable.

In addition, isolation and home confinement can lead to adverse effects on socio-emotional balance (Gonzalez et al., 2020). This situation becomes even more serious with the uncertainty, fear, loss of hope, and high mortality rates, and infected cases along with the unavailability of a vaccine against COVID-19. Therefore, reports have stated that physiological and psychological impacts of quarantine are wide-ranging, substantial, and can be long-lasting. Stress-related health issues can appear due to academic workload pressure related to the sudden change in their lifestyles with a limited time-frame. Ultimately, this condition could cause suicide in extreme cases (Feast & Bretag, 2005).

Considering the situation where some of the students who have left their homes, within the same country or abroad, had to adjust to a situation of confinement since they are unable to return to their homes due to restrictions imposed and closure of airports and borders. The isolation associated with self-confinement leads to the loss of social contact and socialisation routines that are an essential part of a student's daily experience. Therefore, the disruption of their socio-emotional balance will negatively affect their mental health (UNESCO & IESALC, 2020). According to a survey conducted in late March, 75% of higher education students in the U.S. reported they have suffered from anxiety and stress. There are similar results from European surveys of exchange students conducted around the same time (Wim & Benke-Åberg, 2020).

According to Figure 4, 41.2% of the respondents reported different levels of anxiety and stress during the period. 31.4% of those who had not been able to start their exchanges experienced anxiety and stress to a great extent, and 30.6% of those who had stayed in the exchange destination experienced these emotions to a very substantial extent. Moreover, 47.5% had not decided whether to stay or return and 47.5% had returned to their countries. The higher percentage could be a result of the additional stress because of uncertainty with their exchange and decision making.

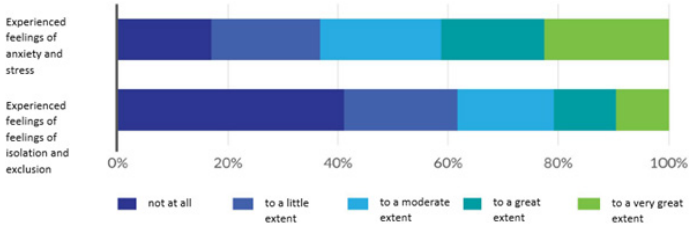

Figure 4: Feelings of anxiety and isolation (Wim & Benke-Åberg, 2020).

It is imperative to pay attention to the mental health and integrate psychological services into the existing academic programmes (UNESCO & IESALC, 2020). The above statistics depict the stress level associated with students at the very early stages of this pandemic and according to the most recent web-based cross-sectional survey conducted in August in Bangladesh also revealed serious impacts on students. Among university students, 82.2 % were experiencing mild to severe depression symptoms and 87.7 % of students were found to have mild to severe anxiety symptoms (Islam et al., 2020). As the COVID-19 pandemic turned out to be devastating and challenging throughout the world, both governments and universities are required to work together to reduce depression and anxiety among students, at least by providing proper mentoring.

Not only mental health, but also physical health can be affected in various ways. Universities were forced to suspend in-person athletics including extracurricular and non-essential student activities which negatively affected students' physical well-being (New York State Department of Health, 2020). In the long run, the lack of physical exercise will lower activity levels and ultimately lead to serious illnesses.

From an academic standpoint, and in support of mental health, it is desirable to provide personalised grading options and give the flexibility to choose credit/no credit or pass/fail grades in lieu of letter grades (American Council on Education, 2020).

7. Quality assurance

Transformations towards online teaching and learning do not just refer to conducting classes and assessments on virtual online platforms. Teaching methods and tools need to be designed and structured, the quality of delivery ensured, and there needs to be alignment between programme learning outcomes and expected student standards (The Quality Assurance Agency for Higher Education, 2020).

Barriers can be presented from the students' end such as mental health issues, learning and understanding difficulties of subject matters and issues with online facilities, etc. Therefore, assessment procedures need risk assessments factoring in students who cannot meet the standards for reasons out of their control.

The Institution of Engineering Technology (IET) has offered guidelines to protect the accreditation status of programmes realising the requirement to adjust the delivery of accredited degrees online in response to reduce the risk of coronavirus transmission (The Institute of Engineering and Technology, 2020). IET accepts the fact that mindful changes will not affect the overall quality of the learning outcomes as required for obtaining the best outcome on virtual platforms.

Laboratory sessions are most likely to be affected unless they are computer-based. It is recommended and encouraged to fulfil the laboratory component later in the programme (The Institution of Engineering and Technology, 2020). Five principles of high-impact teaching practices were found through a case analysis of Peking University. The first principle of appropriate relevance refers to the quantity and difficulty of teaching content in relation to academic readiness (Bao, 2020). Effective delivery is the second principle ensuring students' understanding. Third is the principle of sufficient support fulfilling necessary requirements. High-quality participation is the fourth principle and the last is the principle of contingency plan preparation (Bao, 2020). Consideration to revisit policies and regulations to provide sufficient flexibility for suitable amendments for needful requirements accompanying the virtual committee is a crucial aspect (The Quality Assurance Agency for Higher Education, 2020). Faculty will have to rethink long-term changes in curricula, assessments and approaches to teaching and delivery modes for a more suitable and effective use of online platforms.

It is a quite common scenario that some students consider online exams to be less challenging as a result of "open book", and they have the opportunity to get help from an online resource or their family members or friends. In mitigating such quality assurance issues, academics can utilise the maximum benefits and features of online platforms, for instance shuffling questions and use of question banks and restricting specific times for exams which could minimise academic offenses during examinations.

8. Plans for an uncertain future

The COVID-19 outbreak is unprecedented in its scale, due to globalisation. The many uncertainties associated with COVID-19 include its short-term and long-term implications. Given the ambiguity in the epidemiological and economic outlooks, it is hard to predict when all conventional educational activities can resume. Taking all the uncertainties into consideration, and understanding the global risk, implementing careful planning is called for.

As the COVID-19 pandemic is still not well understood, higher education requires planning for an uncertain future. In the U.S., universities and colleges have exhibited systematic planning based on student-teacher learning and teaching experience and infrastructure, and in analysing the epidemiological and economic outlooks (Bevins et al., 2020).

Another concern regards the impact of student and university partnerships, including internships, especially when it comes to undergraduate and graduate degree programmes. Student mobility and global university partnerships play an important role in their academic and career success in

many ways. Unfortunately, not all subjects and disciplines have the capability to achieve the desired outcomes. One of the big impacts is on international research conferences. Presentation skills in front of the live audience add value for students' personal development. The opportunity to meet people face-to-face and to have meaningful discussions not only to expand and share knowledge but also to get to know fellow researchers and build new research-based collaborations will be extremely limited. Job and career prospects will be adversely affected in the absence of opportunities to meet people in a social network.

One of the measures that could be applied in educational settings to avoid full closure in the long term is to introduce safety protocols. This includes introducing staggered time tables to conduct lectures, splitting classes into small groups, and increased spacing to reduce social contacts while providing a hygienic environment (Ministry of Health, 2020). Universities all over the world are facing critical financial issues due to the freezing of recruitments especially as a result of the loss of international student numbers. The reality of second and third waves of COVID-19 has highlighted the danger of community transmission as a result of on-campus interactions (Murphy, 2020).

According to the current outlook of COVID-19, four phases of higher education have been proposed in response to the continuation of education, and the suggested online learning adoption is shown in Figure 5 (Hill, 2020). Briefly, phase one is all about the rush to Zoom or some sort of online education for the sake of continuity of education. The second phase addresses the quality of emergency delivery and equitable access. Preparation for an extended transition is considered for the third phase. And phase four deals with the emerging new normal situation of post-COVID-19.

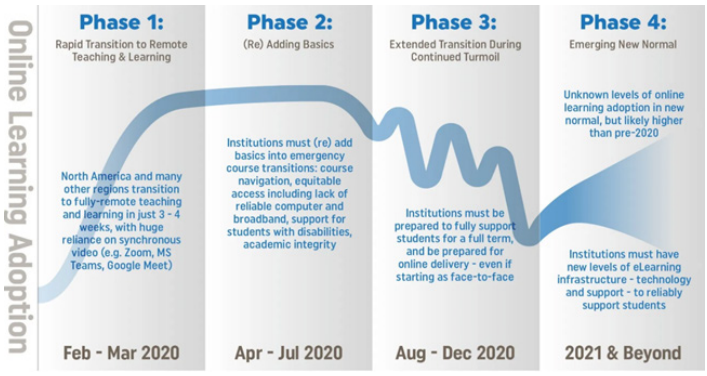

Figure 5: Multiple phases of higher education response to COVID-19 (Hill, 2020).

Looking at the nature of the COVID-19 pandemic, people have foreseen that strict lockdowns are not necessarily the best answer. Therefore, there is a wide variety of efforts worldwide to attempt to move forward mitigating the challenges brought by COVID-19. For instance, universities operate by delivering all classes remotely as much as possible, though essential laboratory and research activities face restrictions in terms of the number of participants and are conducted within a roster or cohorts with staggered timetables (European Centre for Disease Prevention and Control, 2020). Those who travel overseas may require to undergo a 14-day quarantine and to undergo a COVID-19 (PCR) test before entering into the community (New York State Department of Health, 2020). Universities will have to incorporate safety measures and to come up with carefully planned working models ensuring the safety of students and all staff to meet educational and research needs (Minnesota Department of Health, 2020).

9. Discussion and conclusions

It is hoped that this review study will be useful to various interested parties involved in education throughout the globe for a variety of reasons. Although compliance with safety measures and protocols reduces the risk of COVID-19 transmissions, returning to a 'normal' educational status quo ante will not be a straightforward, one-time transition. The process will involve stages of transitions in a controlled protocol-based series of events, as experts assess precautionary measures against second and third waves of the COVID-19 pandemic. The findings will help relevant authorities to improve education initiatives to cope and to keep both students and academics engaged during such an emergency pandemic situation. At least for higher educational settings, hybrid or blended forms will add great value to help improve in-person sessions. Open e-learning along with face-to-face interactive sessions is, for instance, applicable for practical laboratory modules.

Notably, this review study makes a contribution by providing an overview of online tools and methods that help in adapting to virtual platforms during an emergency as well as different important aspects and areas of education that require careful consideration. Undoubtedly, change from traditional teaching settings to the 'new normal' virtual education settings will never be a neutral transition, and we all should expect a certain amount of resistance and controversy during adoption.

Appropriate remediation is required to overcome significant disruptions to higher education which includes long-term plans to deal with the COVID-19 outbreak. This includes introducing support and training for higher education teachers to effectively engage with students in an online environment while continuing their research. Students should also need to be trained to be self-motivated and to act as self-directed learners. Such a teaching model will address a more scalable, more flexible, more engaging environment while keeping the cost reasonable with the required infrastructure.

Experts believe that 'circuit breakers' may need to be switched on and off until a successful COVID-19 vaccine is widely available. Other experts expect to keep COVID-19 restrictions for a year, leading to the education sector working on a roster. There can be implications for continuing to support students' living on-campus. As everyone is stressed, anxious, and depressed, being kind, empathetic, flexible, and compassionate will be highly appreciated. Future improvements such as the availability of 5G and artificial intelligence technology will lead to breakthroughs and are bound to address some of the current limitations by

enabling teaching and communication-rich platforms with high-speed networks. Better integration of technology and education will make students learn more autonomously, potentially following more effective teaching models.

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